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The Chemical Composition of Insecticides and Fungicides



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CORVALLIS

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The Chemical Composition of Insecticides and Fungicides

By

R. H. ROBINSON and C. F. WHITAKER

INTRODUCTION

Before any spray material can be used successfully for the control of insect pests or fungous diseases it is necessary to know, first, what active constituents are present, and second, what amount or percentage of each active ingredient is present. This is especially important since the appearance on the market of many proprietary mixtures having the same active ingredients but in widely different amounts. For example, there are now for sale in the state more than fifty different brands of nicotine compounds that vary from 0.5 percent to 40.0 percent in the active ingredient, nicotine. Likewise, the different brands of sulfur, copper carbonate, dry bordeaux mixture, or any other commercial spray may vary in composition. There are also worthless materials that contain little if any fungicidal or insecticidal properties.

This publication reports the chemical analyses of various spray materials, collected in carrying out the provisions of the Oregon Economic Poison Law. As an aid in obtaining a better understanding of the spray ingredients, the quality and requirements of each kind are discussed briefly.

THE OREGON ECONOMIC POISON ACT

In order to prevent the sale of fraudulent materials and that the farmers may know more definitely regarding the composition of commercial spray materials, the Economic Poison Act was passed by the state legislature in 1923. The Chemist of the Agricultural Experiment Station has been appointed by the Director to supervise and carry out the provisions of the law. All correspondence pertaining to the law should be addressed to the Chemist, Oregon Agricultural Experiment Station, Corvallis, Oregon.

The term "economic poison," patterned after the California usage, has been adopted to mean all materials that are poisonous to insects, fungi, or weeds regardless of whether they are poisonous to human beings or not.

The Economic Poison law provides "that any substance or mixture of substances intended to be used for preventing, destroying, repelling, or mitigating any and all insects, fungi, or weeds shall be registered at the office of the Director of the Oregon Experiment Station and a permit issued therefrom before the same can be offered for sale."

The law also provides that a plainly printed label must be attached to each original package of economic poison stating the following:

1. Name, brand, or trade-mark.
2. Name and percentage of *each active ingredient*.
3. Total inert ingredients.
4. Date of manufacture.
5. Name and address of the manufacturer.

Consumers should examine labels and report to the Chemist of the Agricultural Experiment Station any omission especially pertaining to the active ingredients.

Dealers, salesmen, or other persons selling or offering for sale any economic poison are requested to ascertain from the Chemist of the Agricultural Experiment Station whether or not the material has been registered by the manufacturer. If not, they must register the different brands on their own guarantee or request the manufacturer to register them before they handle them.

LIST OF REGISTERED MANUFACTURERS

During the past season the following manufacturers have registered their products and have been granted a permit for the calendar year 1929.

Acme White Lead & Color Works.....	8250 Aubin St., Detroit, Michigan
American Smelting and Refining Co.....	405 Montgomery St., San Francisco, California
Associated Oil Co.....	79 Montgomery St., San Francisco, California
American Cyanamid Sales Co.....	Azusa, California
An-Fo Manufacturing Co.....	3129 Elmwood Ave., Oakland, California
Antrol Laboratories.....	651 Imperial St., Los Angeles, California
Balfour Guthrie & Co.....	351 California St., San Francisco, California
Bayer-Semesan Co.....	105 Hudson St., New York City
Bear Creek Spray Corp.....	Medford, Oregon
Buhack Producing & Mfg. Co.....	37 E. Channel St., Stockton, California
Braun-Knecht-Heimann Co.....	584 Mission St., San Francisco, California
California Spray-Chemical Co.....	Watsonville, California
California Rex Spray Co.....	Benicia, California
Chemical Products Co.....	Maritime Bldg., Seattle, Washington
Chipman Chemical Engineering Co.....	Bound Brook, New Jersey
Cooper, Wm. & Nephews.....	1909 Clifton Ave., Chicago, Illinois
Cowles-Lamgenheim.....	6561 Santa Monica Blvd., Los Angeles, California
D & B Chemical Co.....	800 E. 37th St., Portland, Oregon
Danforth Chemical Co.....	Willard St., Leominster, Massachusetts
Devoe and Reynolds.....	14 West Lake St., Chicago, Illinois
Dow Chemical Co., The.....	Midland, Michigan
Dryzem Co., The.....	1429 Sacramento St., Portland, Oregon
Durbocide Chemical & Machine Corp.....	1197 Union Ave., Portland, Oregon
Feeds & Fertilizer Inc.....	321 E. Salmon St., Portland, Oregon
Forsell & Co., M. J.....	2224 5th Ave., Seattle, Washington
Gas, Grain Treater Co., The.....	495 Hawthorne Ave., Portland, Oregon
General Chemical Co.....	201 Sansome St., San Francisco, California
Gideon Stolz Co.....	Salem, Oregon
Gleason, R. E.....	Freewater, Oregon
Grasselli Chemical Co., The.....	Cleveland, Ohio
Hammond's Paint and Slug Shot Works.....	Beacon, New York
Hemingway Co., The.....	Shellmound and Horton Strs., Oakland, California
Hood River Spray Co.....	Hood River, Oregon
Hooker Electrochemical Co.....	25 Pine St., New York City
Latimer-Goodwin Chemical Co., The.....	Grand Junction, Colorado
Leckenby, Harry N.....	Pier No. 40, Seattle, Washington
Lee Co., George H.....	1115 Harney St., Omaha, Nebraska
LeGear Medicine Co., Dr. L. D.....	4161 Beck Ave., St. Louis, Missouri
Leis, B.....	Beaverton, Oregon
Lilly Co., The Chas. H.....	Seattle, Washington
Lucas Kil-Tone Co.....	Vineland, New Jersey
Michel & Pelton Co.....	5743 Landregon St., Emeryville, California
Miller Products Co.....	Foot of Lincoln St., Portland, Oregon
Montgomery Ward & Co.....	Portland, Oregon
Mountain Copper Co., The.....	112 Market St., San Francisco, California
Mt. Hood Soap Co., The.....	270 Glisan St., Portland, Oregon
Mulford Co., H. K.....	Broad & Wallace Strs., Philadelphia, Pennsylvania
McIntyre, Wm. A.....	R. F. D. No. 1, Beaver Creek, Oregon
McLaughlin Gormley King Co.....	1715 5th St., Minneapolis, Minnesota
National Chemical Co.....	310 Sansome St., San Francisco, California
Niagara Sprayer and Chemical Co.....	Middleport, New York
Nicotine Production Corporation.....	Clarksville, Tennessee
Nichols Copper Co.....	25 Broad St., New York City
Parke Davis and Co.....	Foot of McDougall St., Detroit, Michigan
Pittsburg Plate Glass Co., Corona Chem. Div.....	205 Pittsburg Ave., Milwaukee, Wisconsin

Portland Gas & Coke Co.....	Portland, Oregon
Roessler and Hasslacher Chem. Co., The.....	709 Sixth Ave., New York City
San Francisco Sulfur Co.....	636 California St., San Francisco, California
San Jose Spray Mfg. Co.....	585 Emery St., San Jose, California
Sexton Co., Leonard.....	Freewater, Oregon
Sherwin-Williams Co., The.....	1450 Sherwin Ave., Oakland, California
Sutherland Spray Co.....	Sutherland, Oregon
The Dalles Spray Co.....	The Dalles, Oregon
Tobacco By-Products and Chemical Corp.....	Louisville, Kentucky
U. S. Smelting Refining and Mining Co.....	Newhouse Bldg., Salt Lake City, Utah
Valley Fruit Co.....	Walla Walla, Washington
Wheeler, Reynolds and Stauffer.....	624 California St., San Francisco, California
Wiarda & Co., John C.....	200 5th Ave., New York City
Yakima Valley Spray Co.....	Yakima, Washington

If any brands of economic poison are offered for sale that have not been registered by one of the foregoing manufacturers, the Chemist of the Agricultural Experiment Station should be notified. Such materials should be considered questionable until the manufacturer registers and guarantees them.

Another important purpose of the law is to prevent the sale of those materials that have little or no value as an economic poison. As stated in Section 8 of the law, "the Director of the Experiment Station has power to refuse to register any material that has been shown to have little or no value for the purpose for which it is intended to be used." Thus far registration has been denied five worthless materials and their sale discontinued.

INSPECTION, COLLECTION, AND ANALYSES OF SAMPLES

During the active spraying season representative samples of different brands of insecticides, fungicides, and weed killers are collected and analyzed. Those brands that show a lower percentage of active ingredients than is guaranteed by the manufacturer receive especial attention. The manufacturer is notified to change the guarantee or improve his product. If he fails repeatedly to do so or in any other way violates the provisions of the act, legal action is taken against him. Dealers, moreover, are requested not to handle the product, and publicity is given advising against its use.

During the year 1929 there were more than 300 different brands of economic poisons registered. On account of the large number available it is impossible to obtain samples of all brands. Instead, attention is centered on certain classes of materials, especially those spray materials that are subject to chemical changes. Certain manufacturers also are more careful than others and their products may be depended upon as being in accordance with their guarantee. These may necessitate only occasional attention.

New brands and new spray materials are promptly given especial attention. The Agricultural Chemistry department in cooperation with other departments of the Agricultural Experiment Station will be pleased to give available information and advice regarding the composition and the use of this class of sprays.

ANALYTICAL REPORT OF SAMPLES

In the following pages are reported the guaranteed and found composition of economic poisons collected during the past season. Comments are also made relative to the chemical nature and stability of each material.

Lime-sulfur solution. Sulfur, chemically combined with calcium to form calcium polysulfide, is the principal active ingredient in lime-sulfur solution. For all practical purposes its concentration is indicated by the hydrometer test which, for commercial brands, should be at least 30° Baumé.

Lime-sulfur solution as locally prepared is subject perhaps to greater variation in composition than most sprays. When a poor grade of lime is used or the operator is careless in boiling the solution, the Baumé reading may be low. The orchardist is advised to test the lime-sulfur solution with a Baumé hydrometer and make dilutions for spraying in accordance with Table II of Oregon Experiment Station Bulletin 201. If the test is below the Baumé guaranteed on the label it should be reported immediately to the Agricultural Chemistry department of the Experiment Station. A pint sample also should be sent with the report.

Manufacturers are requested to label all barrels of lime-sulfur solution showing the minimum Baumé reading guaranteed by them. Although the Baumé reading would indicate approximately the strength of the lime-sulfur solution, the polysulfide sulfur and the total sulfur percentages are also given. The results are reported in Table I.

From the results in Table I it is apparent that some brands are below the guarantee. The deficiency, although small, should not be overlooked.

TABLE I. LIME-SULFUR SOLUTION

Name of manufacturer	Address	Guaranteed and found	Baumé degrees	Total sulfur	Calcium polysulfide
				%	%
B. Leis	Beaverton, Oregon	Guaranteed	30.0	.....	.....
		Found	29.7	22.8	26.7
Bear Creek Spray Co.	Medford, Oregon	Guaranteed	32.0	.....	.....
		Found	33.4	25.5	30.6
Gideon Stolz Co.	Salem, Oregon	Guaranteed	30.0	.....	.....
		Found	29.8	23.4	28.2
Hood River Spray Co.	Hood River, Oregon	Guaranteed	32.0	.....	.....
		Found	32.0	25.1	30.1
Miller Products Co.	Portland, Oregon	Guaranteed	30.0	22.1	.....
		Found	32.3	24.4	29.4
Montgomery Ward & Co.	Portland, Oregon	Guaranteed	30.0	22.1	26.4
		Found	32.0	24.3	29.3
National Chemical Co.	San Francisco, California	Guaranteed	32.0	25.0	29.0
		Found	32.0	24.9	30.4
Sutherlin Spray Co.	Sutherlin, Oregon	Guaranteed	30.0	.....	.....
		Found	30.6	21.9	25.6
The Chas. H. Lilly Co.	Seattle, Washington	Guaranteed	31.0	.....	.....
		Found	32.0	24.8	30.1
The Dalles Spray Co.	The Dalles, Oregon	Guaranteed	30.0	.....	.....
		Found	27.0	18.6	20.8
Valley Fruit Co.	Walla Walla, Washington	Guaranteed	32.0	.....	25.0
		Found	32.6	25.1	30.4
Yakima Valley Spray Co.	Yakima, Washington	Guaranteed	31.5	.....	.....
		Found	31.3	24.7	29.0

Dry lime-sulfur. There are several brands of dry lime-sulfur sold in Oregon. Although a powder, this is not a dusting spray but must be dissolved in water before it is applied. The dry lime-sulfur should give as effective results as the liquid lime-sulfur if used in equivalent amounts.

This amount should be at the rate of 5.0 pounds of the dry material for each gallon of concentrated lime-sulfur required.

The different brands of the dry lime-sulfur vary somewhat in composition. They should contain a minimum of 65.0 percent of calcium polysulfide, the principal active ingredient, and not more than 12 percent free uncombined sulfur. Even a higher amount of calcium polysulfide is desirable. It is important, therefore, to note the guaranteed statement on the label and to examine the analytical report given in Table II.

Unless dry lime-sulfur is kept in nearly air-tight containers it may partly decompose, whereupon, owing to the decreased polysulfide content of the oxidized material, its value as a dormant spray is greatly diminished.

The analysis given in Table II shows that some of the brands are below the guaranteed amount of the main active ingredient, calcium polysulfide. On the other hand, the free sulfur is higher than the guarantee. This combination decreases the value of the material as dormant spray although the excess free sulfur may be beneficial in summer sprays.

Unless dry lime-sulfur is packed in air-tight containers it should be used soon after it is placed on the market. Otherwise it deteriorates rapidly and its value as a spray is greatly diminished.

TABLE II. DRY LIME-SULFUR

Name of manufacturer	Address	Guaranteed and found	Calcium poly sulfide	Calcium thio-sulfate	Free sulfur
			%	%	%
Acme White Lead & Color Works	Detroit, Michigan	Guaranteed	70.00	5.00	10.00
		Found	63.44	5.18	12.60
Devoe & Reynolds Co.	Chicago, Illinois	Guaranteed	70.00	5.00	8.00
		Found	72.25	13.70	8.60
Lucas-Kil-Tone	Vineland, New Jersey ..	Guaranteed			
		Found	70.27	4.87	11.13
Montgomery Ward & Co.	Portland, Oregon	Guaranteed	70.00	5.00	10.00
		Found	55.90	7.10	15.50
The Dow Chemical Co.	Midland, Michigan	Guaranteed	70.00	5.00	10.00
		Found	68.80	6.98	4.48
The Hemingways Co.	Oakland, California	Guaranteed	63.00	4.00	10.00
		Found	56.50	5.68	14.10
The Sherwin-Williams Co.	Oakland, California	Guaranteed	65.00	5.00	10.00
		Found	59.45	6.08	15.90

Lead arsenate. The lead arsenate used in Oregon is mainly the lead hydrogen arsenate form. This form is more toxic than the basic or neutral type and consequently the latter is rarely used in this state. Lead hydrogen arsenate is a standardized product that does not vary greatly in composition. It can be relied upon generally to be in accordance with the guarantee. The analyses of the different brands as shown in Table III further confirm this statement. Where the manufacturer has guaranteed 98 percent lead arsenate it is assumed that the product will contain a minimum of 30.0 percent arsenic oxide and 63.0 percent lead oxide.

TABLE III. LEAD ARSENATE

Name of manufacturer	Address	Guaranteed and found	Total arsenic oxide	Total lead oxide	Arsenic oxide water soluble
			%	%	%
Acme White Lead and Color Works	Detroit, Michigan	Guaranteed	32.4	.....	.75
		Found	32.2	64.4	.09
California Spray Chem- ical Co.	Watsonville, California	Guaranteed	30.0	.....	.75
		Found	31.5	64.8	.04
Chipman Chem. Engi- neering Co.	Bound Brook, New Jersey	Guaranteed	30.0	63.0	.75
		Found	32.0	63.4	.27
Devoe & Raynolds	Chicago, Illinois	Guaranteed	30.0	.....	.70
		Found	32.9	64.0	.27
General Chem. Co.	San Francisco, Cali- fornia	Guaranteed	30.0	.....	.25
		Found	31.4	63.4	.04
Lucas Kil-Tone Co.	Vineland, New Jersey	Guaranteed	31.8	.....	.75
		Found	31.7	63.6	.08
National Chem. Co.	San Francisco, Cali- fornia	Guaranteed	30.0	.....	.50
		Found	30.6	63.4	.03
The Dow Chemical Co.	Midland, Michigan	Guaranteed	30.0	.....	.45
		Found	31.2	63.2	.20
The Grasselle Chem. Co.	Cleveland, Ohio	Guaranteed	30.0	63.0	.75
		Found	31.5	63.0	.06
The Latimer-Goodwin Chem. Co.	Grand Junction, Colo- rado	Guaranteed	31.1	63.0	.75
		Found	29.2	64.4	.07
The Sherwin-Williams Co.	Oakland, California	Guaranteed	32.4	.....	.75
		Found	31.2	63.2	.12

Calcium arsenate. There are a few brands of calcium arsenate offered on the Oregon market. On account of the unstableness of this arsenical it cannot be used safely as an orchard spray and consequently local demand for it is comparatively small. Calcium arsenate can be substituted advantageously for paris green for most purposes, especially in truck garden insect pest control. It costs less than paris green, contains 40 percent of the active ingredient arsenic oxide, and is less water soluble.

As reported in Table IV, two samples of two different brands of calcium arsenate contained excessive amounts of water-soluble arsenate. While this is abnormal on account of storage conditions of old stock an effort is made to stop the distribution of such samples.

TABLE IV. CALCIUM ARSENATE

Name of manufacturer	Address	Guaranteed and found	Arsenic oxide Water soluble	
			%	%
Acme White Lead & Color Works.....	Detroit, Michigan.....	Guaranteed	40.5	.75
		Found	43.0	Trace
Devoe & Raynolds.....	Chicago, Illinois.....	Guaranteed	40.0	.75
		Found	40.9	6.05
General Chemical Co.....	San Francisco, Cali- fornia	Guaranteed	41.0	.75
		Found	40.9	5.17
Sherwin-Williams Co.....	Oakland, California	Guaranteed	40.0	.50
		Found	42.8	.05

Paris green. Although paris green has been superseded by calcium arsenate and lead arsenate it is still in demand and available on the Oregon market. It finds an important place as the active ingredient of insect baits that cannot be used as a foliage spray. It may contain as much as 3.5 percent water-soluble arsenic oxide, which, owing to danger of causing foliage burn, limits its use to hardy plants without causing foliage burn.

TABLE V. PARIS GREEN

Name of manufacturer	Address	Guaranteed and found	arsenous oxide	Copper oxide	Arsenic oxide water soluble
			%	%	%
Acme White Lead and Color Works	Detroit, Michigan	Guaranteed	50.0	-----	3.50
Chipman Chemical Engi- neering Corp.	Bound Brook, New Jersey	Found	61.2	30.6	2.82
		Guaranteed	50.0	-----	3.50
		Found	54.7	31.3	0.64
Devoe and Raynolds	Chicago, Illinois	Guaranteed	50.0	-----	3.50
		Found	55.4	30.6	2.23
The Sherwin-Williams Co.....	Oakland, California	Guaranteed	50.0	-----	3.50
		Found	56.5	30.2	1.91

Nicotine compounds and dusts. Especial care should be exercised in the purchase and subsequent handling of certain nicotine combinations. The dealer, also, who retails nicotine sprays should thoroughly understand the different combinations. This is important because some lose their nicotine content very rapidly, while others may be kept indefinitely without loss of the active ingredient.

Nicotine sulfate in liquid form is very stable and may be kept indefinitely without deterioration. The highest grade form is a solution of nearly 50 percent nicotine sulfate in water containing 40 percent nicotine. It is sold on the Oregon market as "Black Leaf 40," Hall's 40 percent nicotine, N. P. C. Nicotine, and Ortho nicotine sulfate.

Nicotine dusts may or may not be stable compounds. The stability of the combination depends upon the carrier used to hold the nicotine. The importance of nicotine dusts warrants detailed explanation.

In the preparation of nicotine dusts the use of some carrier or filler is necessary to hold the alkaloid which is the active ingredient and distribute it uniformly as a powder. Thatcher and Streeter of the New York Agricultural Experiment Station classify the carriers in three divisions:

First, "absorbent" carriers, which tend to prevent volatilization of the nicotine. This class of materials may be represented by talc, kaolin, and kieselguhr.

Second, "inert" carriers, which have no other effect than to distribute the nicotine so as to expose a larger surface for evaporation. This class may be represented by gypsum, sulfur, and slate dust.

Third, "active" carriers, which increase the volatility of the nicotine sulfate by changing it to a more volatile form. This class may be represented by hydrated lime, calcium carbonate (limestone), and magnesium carbonate.

Immediately after nicotine sulfate is mixed with one or more of the several carriers or fillers the probability of loss may be summarized as follows:

(1) With hydrated lime or calcium carbonate (limestone) significant losses will occur rapidly. Air-tight containers prevent this loss to a very limited extent only. Notable losses under these conditions have been observed, due perhaps, to chemical changes. In paper bags half or more of the nicotine may be lost in thirty days. In cartons practically all the nicotine would be lost in six months.

(2) When any of the absorbent or inert carriers are used together with either hydrated lime or calcium carbonate similar losses may be expected as noted under (1).

(3) With kaolin, talc, kieselguhr, sulfur, or similar carriers, no appreciable losses may be anticipated.

(4) Tobacco leaf or waste pulverized dust will not lose its nicotine unless hydrated lime is mixed with it.

From the foregoing it is apparent that unless the carrier is known, any commercial nicotine dust should be used as soon as possible after it has been prepared. Dust held over from the previous season should be discarded unless it is known that only "absorbent" or "inert" carrier was used in the mixture. It is not advisable to purchase nicotine dusts taken from broken packages.

TABLE VI. NICOTINE COMPOUNDS

Brand	Name of manufacturer	Address	Guaranteed and found	Nicotine
				%
Acme nicotine	Acme White Lead and Color Works	Detroit, Michigan	Guaranteed	40.0
			Found	40.3
Afi-Tox	California Rex Spray Co.	Benicia, California	Guaranteed	4.0 Also soap 10.0
			Found	4.4 Also soap 14.9
Aphido	Miller Products Co.	Portland, Oregon	Guaranteed	10.4
			Found	9.30
"Black Leaf 40"	Tobacco By-products & Chemical Corp.	Louisville, Kentucky	Guaranteed	40.0
			Found	40.8
"Nico-Fume" Liquid	Tobacco By-products & Chemical Corp.	Louisville, Kentucky	Guaranteed	40.0
			Found	41.1
"Nico-Fume" Powder	Tobacco By-products & Chemical Corp.	Louisville, Kentucky	Guaranteed	12.5
			Found	13.7
Nicotine Spray	Michel & Pelton	Emeryville, California	Guaranteed	1.0 Also soap 20.0
			Found	0.9 Also soap 23.8
N. P. C. Nicotine	Nicotine Production Corporation	Clarksville, Tennessee	Guaranteed	40.0
			Found	40.6
Tobacco Soap Spray	The Chas. H. Lilly Co.	Seattle, Washington	Guaranteed	2.0 Also soap 6.0
			Found	2.4 Also soap 7.3
Wardgrade Nicotine	Montgomery Ward & Co.	Portland, Oregon	Guaranteed	40.0
			Found	40.2

Nicotine dusts may be home-prepared satisfactorily. Directions for the preparation of these dusts may be obtained by writing to the Chemistry department of the Oregon Agricultural Experiment Station.

During the past season samples of the various nicotine compounds were collected. Only new stock samples were analyzed although several brands of old stock were inspected. No doubt the old stock would be deficient in nicotine and the dealers were advised accordingly. The persons or firms having last year's goods were advised to handle only what could be disposed of during the active spraying season.

Tables VI and VII contain the results of analyses.

TABLE VII. NICOTINE DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Nico- tine	Sul- fur	
				%	%	
Ammo-Nico Dust	Durbocide Chemi- cal & Machine Corp.	Portland, Or- egon	Guaranteed Found	2.4 1.5		
Niagara A-1 Dust	Niagara Sprayer Co.	Middleport, New York	Guaranteed Found	2.7 2.3		
Niagara All- in-One	Niagara Sprayer Co.	Middleport, New York	Guaranteed Found	1.0 .7	75.0 71.8	Also arsenic oxide 2.7% Also arsenic oxide 2.9%
Niagara No. 10	Niagara Sprayer Co.	Middleport, New York	Guaranteed Found	3.3 3.8		
Niagara No. 6		Middleport, New York	Guaranteed Found	2.0 2.3		
N. S. P. Dust	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found			
Super Tox	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found	6.0 5.7		

Sulfur and miscellaneous dusts. In this classification are placed the powdered sulfurs, sulfur-lead arsenate, sulfur-hydrated lime, bordeaux-lead arsenate, and almost any other combination.

It is important to examine the label of these dusts in order to know how much of the active ingredients the dust is guaranteed to contain. Some of them may consist mainly of cheap, inert filler combined with enough of the active poison to permit its sale legally as an insecticide or fungicide. Table VIII contains the analyses of a limited number of these samples, most of which are high grade.

TABLE VIII. SULFUR AND MISCELLANEOUS DUSTS

Brand	Name of manufacturer	Address	Guaranteed and found	Arsenic %	Sulfur %	Copper %
Dritomic Sulfur	General Chem. Co.	San Francisco, California	Guaranteed Found	..... .....	90.0 86.7	..... .....
Dry mix Sulfur	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found	..... .....	64.0 78.7	..... .....
Dusting sulfur	Montgomery Ward & Co.	Portland, Oregon	Guaranteed Found	..... .....	98.5 96.2	..... .....
Garden guard.	Acme White Lead & Color Works	Detroit, Michigan	Guaranteed Found	3.0 3.4	4.0 3.8	.5 .5
Garden insecticide	Dr. L. D. LeGear Medicine Co.	St. Louis, Missouri	Guaranteed Found	3.0 3.6	19.5 18.7	..... .....
Mulsoid sulfur	Sherwin-Williams Co.	Oakland, California	Guaranteed Found	..... .....	95.5	.....
Niagara Copo-dust	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	..... .....	..... .....	6.9 7.4
Niagara D-6	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	..... .....	..... .....	6.4 6.9
Niagara Ento dust	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	30.0 32.2	..... .....	..... .....
Niagara D-20	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	7.3 7.6	..... .....	6.4 6.6
Niagara 85-15	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	4.4 5.0	..... .....	..... .....
Orchard Ka-linex	General Chem. Co.	San Francisco, California	Guaranteed Found	38.9 39.8	..... .....	..... .....
Pomo-dust	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	87.0 86.3	..... .....	..... .....
Rose Dust	Durbocide Chem. & Machine Corp.	Portland, Oregon	Guaranteed Found	4.4 3.1	..... .....	8.1 9.2
Sulfo	Miller Products Co.	Portland, Oregon	Guaranteed Found	..... .....	80.0 86.8	..... .....
Sulfo-dust	Niagara Sprayer & Chem. Co.	Middleport, New York	Guaranteed Found	..... .....	92.0 90.9	..... .....
Sure Noxem	Devoe & Reynolds	Chicago, Illinois	Guaranteed Found	2.0 3.1	6.0 17.2	 0.6

Dry bordeaux mixture. The different brands of commercial bordeaux mixture are subject to considerable variation in the active ingredient copper. Nearly as important, however, is the physical condition of the material. Field experiments have shown that unless the powder is superfine it will

not adhere sufficiently long to give control comparable with the home-prepared bordeaux mixture.

Table IX shows that most of the dry bordeaux mixtures are in accord with the manufacturer's guarantee for the amount of the active ingredient copper.

TABLE IX. BORDEAUX MIXTURES

Brand	Name of manufacturer	Address	Guaranteed and found	Copper
				%
Acme Bordeaux	Acme White Lead & Color Works	Detroit, Michigan	Guaranteed Found	12.75 13.25
Chipman Bordeaux	Chipman Chem. Eng. Co.	Bound Brook New Jersey	Guaranteed Found	13.00 13.10
Devoe Bordeaux	Devoe & Reynolds	Chicago, Illinois	Guaranteed Found	13.00 14.35
Fungi-Bordo	The Sherwin-Williams Co.	Oakland, California	Guaranteed Found	12.75 13.00
Ortho-Bordeaux	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	12.75 13.40
Rex Borco	California Rex Spray Co.	Benicia, California	Guaranteed Found	17.00 18.83

TABLE X. COPPER CARBONATE AND COPPER SULFATE

Brand	Name of manufacturer	Address	Guaranteed and found	Copper
				%
"Carbo"	Miller Products Co.	Portland, Oregon	Guaranteed Found	53.0 53.1
Copper Carbonate	Mountain Copper Co.	San Francisco, California	Guaranteed Found	54.0 53.2
Copper Carbonate	John C. Wiarda & Co.	New York, N. Y.	Guaranteed Found	54.6 53.8
Copper Carbonate	Nichols Copper Co.	New York, N. Y.	Guaranteed Found	53.0 53.8
Corona Copper-Carb.	Pittsburg Plate Glass Co.	Milwaukee, Wisconsin	Guaranteed Found	18.0 20.4
Miller Copper Sulfate	Miller Products Co.	Portland, Oregon	Guaranteed Found	25.4
Nichols Copper Sulfate	Nichols Copper Co.	New York, N. Y.	Guaranteed Found	25.2 25.3
"Ortho" Copper Sulfate	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	23.0 24.1
"Selby" Copper Sulfate	American Smelting & Refining Co.	San Francisco, California	Guaranteed Found	25.2 25.3

Copper carbonate and copper sulfate. Copper carbonate has been found very effective and less injurious than the older types of fungicides for bunt control in wheat. Similar to bordeaux mixture, the fineness of the

dust particles is an important consideration. Most of the commercial brands have been improved to the extent that all particles pass through a 200-mesh sieve. This degree of fineness has been found satisfactory for effective adherence to the wheat seed. Copper sulfate is available in the market in both the crystalline and powder forms.

Table X contains the analyses of samples of copper carbonate inspected during the past season.

Copper and arsenic preparations and compounds. These preparations are usually mixtures of lead arsenate and dry bordeaux mixture. Table XI reports the relative amounts of copper and arsenic oxide present in the mixtures.

TABLE XI. COPPER AND ARSENIC PREPARATIONS

Brand	Name of manufacturer	Address	Guaranteed and found	Arsenic oxide		Copper
				%	%	
Garden Guard...	Acme White Lead & Color Works....	Detroit, Mich- igan	Guaranteed	2.6	1.1	Also 4.0% sulfur Also 3.8% sulfur
			Found	2.8	1.7	
Niagara D. 20..	Niagara Sprayer & Chem. Co.	Middleport, New York....	Guaranteed	7.6	6.5	
			Found	8.1	6.7	
S. W. Pestroy..	The Sherwin-Wil- liams Co.	Oakland, Cali- fornia	Guaranteed	11.0	4.3	
			Found	10.5	3.8	
2-Way Spray ..	Acme White Lead & Color Works....	Detroit, Mich- igan	Guaranteed	4.3	11.0	
			Found	4.3	10.5	

Oil sprays. Miscible oils and various oil emulsions are manufactured from kerosene and the heavier mineral oils. It is necessary that a good quality emulsion be produced in order that the oil may be dispersed uniformly throughout the diluted spray. If the oil separates out injury to the tree may ensue.

Two types of emulsions are now available: one in which the oil is emulsified with soap and cresylic acid or soap alone and the other, a non-soap emulsion, in which the oil is dispersed by means of a protein material such as casein or some other emulsifying agent. The latter may be termed a "quick breaking" type emulsion. More trouble may be experienced with this type, and care should be taken to see that the oil does not separate out in the spray tank.

In preparing the emulsions various other ingredients are sometimes added depending upon the formula of the manufacturer. The oil content, however, is the main active ingredient. The percentage of oil found in several commercial brands is given in Table XII.

TABLE XII. OIL EMULSIONS

Brand	Name of manufacturer	Address	Guaranteed and found	Oil (by volume)
				%
Avon Emulsion	Associated Oil Co.	San Francisco, California	Guaranteed Found	84.0 87.5
Caseinate Emulsion	Robert E. Gleason	Freewater, Oregon	Guaranteed Found	60.0 73.6
Del Monte Spray	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	 90.1
Dormoil	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found	84.0 85.0
Extermol	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found	80.0 82.8
Free-Mulsion	The Sherwin-Williams Co.	Oakland, California	Guaranteed Found	83.0 83.7
Neutral Emulsion	Balfour-Guthrie Co.	San Francisco, California	Guaranteed Found	77.0 90.0
Orthol K Light	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	83.0 85.5
Orthol K Medium	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	83.0 85.3
Ortho Kleenup Oil "A"	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	83.0 85.3
Ortho Kleenup Oil "B"	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	75.0 80.7
Petrotine	Associated Oil Co.	San Francisco, California	Guaranteed Found	83.0 88.5
Sum-R-Oil	Hood River Spray Co.	Hood River, Oregon	Guaranteed Found	80.0 83.6
Volck Light	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	83.0 83.3
Volck Concentrate	California Spray Chem. Co.	Watsonville, California	Guaranteed Found	83.0 83.6

Formaldehyde. Formaldehyde is another commonly used fungicide. All formaldehyde containers should be carefully labeled showing a minimum of 37.0 percent by weight. Consumers should demand this guarantee before accepting any shipments of formaldehyde. Table XIII shows the grade of products inspected during the past season.

TABLE XIII. FORMALDEHYDE

Name of manufacturer	Address	Guaranteed and found	Formaldehyde (by wt.)
			%
Braun-Knecht-Heimann Co.	San Francisco, California	Guaranteed	37.0
		Found	37.6
D & B Chemical Co.	Portland, Oregon	Guaranteed	37.3
		Found	33.8
The Roessler & Hanlacher Co.....	New York, New York	Guaranteed	37.0
		Found	37.4

Soap. Several brands of soap are offered on the market primarily as spray soaps. These are guaranteed to be either whale-oil or fish-oil products. There are also the "hard" and "soft" whale-oil soaps. The soft soaps are the potash soaps, while the hard types are soda soaps. It is well to examine the label and purchase the soap on the guaranteed actual weight of the dry soap.

Mercuric fungicides. Recently several organic mercury compounds have been developed that have proved effective as fungicides and insecticides. Among these compounds may be listed semesan, seed-san, chlorophol, germisan, uspulum, and others. These are listed in Table XIV.

Miscellaneous spray materials. The guaranteed and found amounts of the active ingredients of various miscellaneous materials are given in Table XIV. The purposes for which they are intended are self-evident from the active ingredients present. Most of the analyses are above the manufacturer's guarantee.

TABLE XIV. MISCELLANEOUS INSECTICIDES AND FUNGICIDES

Brand	Name of manufacturer	Address	Guaranteed and found	Active ingredients %
Aphisite	H. N. Leckenby	Seattle, Washington	Guaranteed	Soap 48.0 Essential oil 2.0 Ammonia 5.0
Atlacide	Chipman Chem. & Eng. Co.	Bound Brook, New Jersey	Found	Soap 43.7 Essential oil present Ammonia 1.6
Bait-M	Acme White Lead & Color Works	Detroit, Michigan	Guaranteed	Calcium chlorate equivalent 57.5
			Found	Calcium chlorate equivalent 57.1
Bill's Dandelion Weed Killer	W. A. McIntyre	Beaver Creek, Oregon	Guaranteed	Arsenic oxide 2.3
			Found	Arsenic oxide 0.8
Ceresan	The Bayer-Semesan Co.	New York, New York	Guaranteed	Arsenic oxide .2 Muratic acid 25.0
			Found	Arsenic oxide .3 Muratic acid 24.8
Cyanogas	American Cyanamid Sales Co.	Azusa, California	Guaranteed	Ethyl Mercury Chloride 1.6
			Found	Ethyl Mercury Chloride 1.4
Derrisol	Wm. Cooper & Nephews	Chicago, Illinois	Guaranteed	Calcium cyanide 40.0
			Found	Calcium cyanide 40.6
Evergreen	McLaughlin, Garmele, King Co.	Minneapolis, Minnesota	Guaranteed	Extract 5.0
			Found	Derris present
Hellebore	Durbocide Chem. & Machine Co.	Portland, Oregon	Guaranteed	Pyrethrum Oleo Resin 11.5
			Found	Pyrethrum Resin as solids
London Purple	Acme White Lead & Color Works	Detroit, Michigan	Guaranteed	Hellebore alkaloid 1.0
			Found	Hellebore alkaloid present
Maggotbate	The Chas. H. Lilly Co.	Seattle, Washington	Guaranteed	Arsenate and arsenite 42.0
			Found	Arsenate and arsenite 41.0
Paracide	Hooker Electric Chem. Co.	New York, New York	Guaranteed	Anthracene oil 0.75
			Found	Anthracene oil present
Rid-O-Wig	Chemical Products Co.	Seattle, Washington	Guaranteed	Paradichlorobenzene 99.0
			Found	Paradichlorobenzene 99.2
Semesan	The Bayer-Semesan Co.	New York, New York	Guaranteed	Sodium Fluoride 0.1 and Cresol 6.0
			Found	Sodium Fluoride trace and Cresol present
Semesan Bel.	The Bayer-Semesan Co.	New York, New York	Guaranteed	Hydroxymercichlorophenol 30.0
			Found	Hydroxymercichlorophenol 32.4
Semesan Jr.	The Bayer-Semesan Co.	New York, New York	Guaranteed	Hydroxymercichlorophenol 6.0
			Found	Hydroxymercichlorophenol 6.7
Snarol	Antrol Laboratories	Los Angeles, California	Guaranteed	Hydroxymercichlorophenol 12.0
			Found	Hydroxymercichlorophenol 12.6
Whale Oil Soap	Mt. Hood Soap Co.	Portland, Oregon	Guaranteed	Arsenic oxide 2.02
			Found	Arsenic oxide 0.84
Wigotox Bait	Durbocide Chem. & Machine Co.	Portland, Oregon	Guaranteed	Soap 58.5
			Found	Soap 64.8
Weed Killer	Durbocide Chem. & Machine Co.	Portland, Oregon	Guaranteed	Sodium arsenite 5.0
			Found	Sodium arsenite 3.6
			Guaranteed	Sodium chlorate 100.0
			Found	Sodium chlorate 96.0

